Tongue Blade Bite Test Predicts Mandible Fractures

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Abstract

The aim of the study is to evaluate the utility of a simple tongue blade bite test in predicting mandible fractures and use this test as an alternative screening tool for further workup. This is a retrospective chart review. An institutional review board approved the retrospective review of patients evaluated by the Department of Otolaryngology at a single institution for facial trauma performed from November 1, 2011, to February 27, 2014. Patients who had a bite test documented were included in the study. CT was performed in all cases and was used as the gold standard to diagnose mandible fractures. Variables analyzed included age, sex, fracture type/location on CT, bite test positivity, and operative intervention. A total of 86 patients met the inclusion criteria and of those 12 were pediatric patients. Majority of the patients were male (80.2%) and adult (86.0%; average age: 34.3 years). Fifty-seven patients had a negative bite test and on CT scans had no mandible fracture. Twenty-three patients had a positive bite test and a CT scan confirmed fracture. The bite test revealed a sensitivity of 88.5% (95% CI: 69.8–97.6%), specificity of 95.0% (95% CI:86.1–99%), positive predictive value [PPV] of 88.5% (95% CI: 69.8–97.6%), and negative predictive value [NPV] of 95.0% (95% CI: 86.1–99.0%). Among pediatric patients, the sensitivity was 100% (95% CI: 29.9–100%), specificity was 88.9% (95% CI: 68.4–100%), PPV was 75.0% (95% CI: 19.4–99.4%), and NPV was 100% (95% CI: 63.1–100%). The tongue blade bite test is a quick inexpensive diagnostic tool for the otolaryngologist with high sensitivity and specificity for predicting mandible fractures. In the pediatric population, where avoidance of unnecessary CT scans is of highest priority, a wider range of data collection should be undertaken to better assess its utility.

Keywords
- mandible
- trauma
- tongue blade
- pediatrics

Mandible fractures account for 40 to 60% of all facial bone fractures, most commonly in males aged 16 to 30 years. It is among the most common maxillofacial fractures, three times more common than zygomatic fractures and six times more common than maxillary fractures.[1,2] Concomitant injuries are common, with lacerations and neurologic injuries encountered most frequently. In the past, the most common mechanism for these fractures was motor vehicle crashes. There has been a shift in recent years toward violent mechanisms and sporting injuries accounting for most fractures.[2–5] It has also been noted that fewer young children and more adolescents and adults are being treated for mandibular fractures than ever before, possibly due to stringent use of seatbelts and child-restraint devices than in previous years.[2,6] The gold standard for diagnosis is a noncontrasted computed tomographic (CT) scan. However, this is a time-consuming test and the cost and radiation exposure associated with this diagnostic modality raise the question of which patients should receive a CT scan and in which patient a mandibular fracture can be reliably ruled out by history and clinical

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examination alone. In the pediatric population, where avoidance of excess radiation is a concern, others have questioned the utility of CT scans where decisions are often made by clinical exam alone.[7,8] By screening patients in whom a fracture is suspected, unnecessary imaging can potentially be avoided resulting in less cost and harm to the patient as well as less time spent in the emergency room and higher patient turnover.

The tongue blade bite test (TBBT) will be evaluated in this study and consists of inserting a wooden tongue depressor into both sides of the patient's mouth and having the patient bite down while the physician attempts to pull the tongue blade out. If the physician cannot pull the tongue blade out, the test is considered negative. In this study, the sensitivity and specificity of the test compared with CT scans will be analyzed. We also wanted to determine these parameters for the pediatric population where avoidance of unnecessary CT scans is of highest priority.

Review of the literature reveals periodic reference to the TBBT[1,9]; however, there is no prior mention in the literature of the accuracy of this "pull" test as compared with the sensitivity and specificity of the gold standard CT scan. In this study, we aim to show the accuracy of the pull TBBT in predicting mandible fractures in the setting of facial trauma. With this information, we aim to decrease the unnecessary cost and radiation exposure associated with over-imaging patients at low risk of having a mandibular fracture.

Materials and Methods

An institutional review board approved (Louisiana State University Shreveport STUDY000000079) retrospective chart review of patients evaluated by the Department of Otolaryngology at a single institution for facial trauma was performed from November 1, 2011, to February 27, 2014. Patients were identified using the search function of an electronic medical record for various CPT diagnostic codes corresponding to facial trauma. Patients who had a bite test documented on first evaluation by the otolaryngologist were included in the study. Evaluation was performed either acutely in the inpatient setting or subacutely as outpatient. Patients were excluded if they were intubated, unable to tolerate or cooperate for a bite test, or had an obvious open bite deformity or open fracture. CT had been performed in all cases and was used as the gold standard to diagnose mandible fractures. Variables analyzed included age, sex, fracture type/location on CT, bite test positivity, and operative intervention. Eighty-six patients met inclusion criteria and of those 12 were pediatric patients. The majority of the patients were male (80.2%) and adult (86.0% with average age 34.3 years). CT is the gold standard and properties of the bite test (sensitivity, specificity, positive predictive value [PPV], and negative predictive value [NPV]) were determined by comparing its results with those of CT. The results for both tests are shown in ►**Table 1**. Exact 95% confidence intervals (CI) for the proportions were obtained using the binomial distribution. The chi-square test was used to determine the association between sex and age on fracture rates (by CT).

Table 1 Test results for fractures by CT and bite tests ($N = 86$)

Bite/CT test	CT—fractures	CT—no fractures	Total
Bite—fractures	23 (SE = 88.5%) (PPV = 88.5%)	3	26
Bite—no fractures	3	57 (SP = 95.0%) (NPV = 95.0%)	60
Total	26	60	86

Abbreviations: CT, computed tomography; NPV, negative predictive value; PPV, positive predictive value; SE, standard error.

Results

Both the TBBT and CT were performed on 86 patients to diagnose mandibular fractures. Fifty-seven patients had a negative bite test and on CT scans had no mandible fracture. Twenty-three patients had a positive bite test and a CT confirmed fracture. Six patients had bite tests that conflicted with CT findings. CT is the gold standard and properties of the bite test (sensitivity, specificity, PPV, and NPV) were determined by comparing its results with those of CT. The bite test revealed a sensitivity of 88.5% (95% CI: 69.8–97.6%), specificity of 95.0% (95% CI: 86.1–99%), PPV of 88.5% (95% CI: 69.8–97.6%), and NPV of 95.0% (95% CI: 86.1–99.0%). Among pediatric patients, the sensitivity was 100% (95% CI: 29.9–100%), specificity was 88.9% (95% CI: 68.4–100%), PPV was 75.0% (95% CI: 19.4–99.4%), and NPV was 100% (95% CI: 63.1–100%). The results for both tests are shown in ►**Table 1**. Summary statistics for patient characteristics and outcomes are shown in ►**Table 2**. The majority of the patients were male (80.2%) and adult (86%). CT scan identified 26 mandible fractures of various subsites (►**Table 3**). Fracture rate by CT is 30.2% and by bite test is 30.2%. Average age at diagnosis was 34.3 years and ranged from 3 to 101.

The chi-square test was used to determine the association between sex and age on fracture rates by CT. The association between sex and fracture by CT revealed that the proportion of males ($n = 69$) with fractures was 31.9% and female ($n = 17$) fracture rates of 23.5%, p-value = 0.50 (>0.05); hence, surprisingly there was no significant difference

Table 2 Summary statistics for patient characteristics and outcomes ($N = 86$)

Characteristic/Outcome	Number (%) or mean ± SD, median, range
Male sex	69 (80.2)
Adult	74 (86.0)
Age at diagnosis (y)	34.3 ± 16.4, 31.0, 3–101
Had fractures (by CT test)	26 (30.2)
Had fractures (by bite test)	26 (30.2)

Table 3 Fracture locations

Age	Sex	Fracture location	Fracture classification	Bite test
16	M	Angle	Displaced	Pos
34	M	Ramus/Subcondylar/Parasymphyseal	Displaced	Pos
22	M	Symphysis/Parasymphysis/Coronoid	Displaced	Pos
43	M	Angle/Parasymphyseal	Displaced	Pos
22	M	Body	Displaced	Pos
17	M	Condyle/Parasymphyseal	Displaced	Pos
26	F	Condyle/Parasymphyseal	Displaced	Pos
30	M	Angle/Parasymphyseal	Displaced	Pos
43	M	Angle/Parasymphyseal	Displaced	Pos
62	M	Ramus	Displaced	Pos
17	F	Ramus/Condyle/angle	Displaced	Pos
35	M	Ramus/Parasymphyseal	Displaced	Pos
19	M	Body	Displaced	Pos
33	F	Subcondylar	Displaced	Pos
23	M	Subcondylar/Parasymphyseal	Displaced	Pos
18	M	Angle	Displaced (minimally)	Pos
53	M	Coronoid	Displaced (minimally)	Neg
23	M	Ramus/Angle	Displaced (minimally)	Pos
23	M	Ramus/Angle	Displaced (minimally)	Pos
25	M	Angle	Nondisplaced	Pos
23	M	Angle	Nondisplaced	Pos
24	M	Bilateral angles	Nondisplaced	Neg
49	M	Coronoid	Nondisplaced	Pos
54	F	Ramus	Nondisplaced	Neg
39	M	Body	Nondisplaced	Pos
49	M	Subcondylar	Nondisplaced	Pos

Abbreviations: F, female; M, male; Neg, negative; Pos, positive.

between males and females on fracture rate. Adult fracture rate was 31.1% compared with children with a fracture rate of 25.0%, p-value $= 0.67$ (>0.05); hence, there was no significant difference between adults and children.

Discussion

Mandibular fractures account for a high number of maxillofacial fractures encountered by the *facial trauma physician*. The current gold standard for diagnosis is the CT scan. However, owing to the time consumption, high cost, and radiation exposure of this modality, we propose that the TBBT is a suitable screening tool to augment clinical judgment which would allow for avoidance of further imaging in patients with low risk of mandibular fracture. This is especially important in the pediatric population where the risks of radiation exposure are highest. The results of our study showed that the TBBT is a reliable screening tool to add to the diagnostic armamentarium in identify those at high risk of a mandibular fracture from those in which a fracture is unlikely. In this medicolegal climate, physicians often feel pressured to order all tests possible in fear of missing a diagnosis. While CT imaging has become commonplace and remains the standard of care at most trauma facilities for any moderate-to-high impact facial trauma, there are clinical situations where facial trauma is of low impact and clinical judgment and bedside tests such as the TBBT can help determine if a CT may not be warranted.

Our results were comparable with the previously mentioned studies in the literature with various permutations of the bite test. In the study conducted by Alonso and Purcell, the sensitivity and specificity of the TBBT to detect mandibular fractures were 95.7 and 63.5%, respectively.[1] In the prospective study of Schwab et al, the sensitivity and specificity of the TBBT were 95 and 67%, respectively.[6] In our study, the sensitivity and specificity of the TBBT were 89.5 and 93.3%, respectively. In the pediatric population, the sensitivity and specificity were 100 and 87.7%, respectively. From these results, we conclude that the TBBT is a quick, inexpensive diagnostic tool for the *facial trauma physician* with high

sensitivity and specificity for predicting mandible fractures especially in the pediatric population, where avoidance of unnecessary CT scans is of highest priority. However, we advocate that a wider range of data collection should be undertaken to better assess the utility of this test in the pediatric population to achieve tighter confidence intervals. *It is important to note that the test is limited only to pediatric patients that would comply with the test.*

In previous studies, this test had been compared with the sensitivities and specificities of X-ray and panorex.[1,6] Alonso and Purcell conducted a prospective cohort study to determine the sensitivity and specificity of the TBBT using X-ray studies as the gold standard.[1] Schwab et al also conducted a prospective study and determined the sensitivity and specificity of the TBBT as compared with the gold standard of panoramic tomography.[6] Therefore, this study will be the first of its kind in the literature to study the accuracy of the TBBT with the pull method as opposed to the break method mentioned previously, which we hypothesize as safer owing to less force and the lack of a broken wooden tongue blade that may contain sharp edges.

For a few patients, TBBT results did not correlate with CT findings. On review of the false positives, while the patient lacked mandible fractures, all three patients sustained periorbital fractures. This is an interesting finding and can be further evaluated with future studies. In evaluating screening tools, false negatives are always of utmost concern. In our study population, there were three false negatives, and patients who had a negative TBBT and CT were positive for a mandible fracture. On review, one of these patients had a single nondisplaced ramus fracture that was managed conservatively with only a soft diet and the patient did not require fixation or operative intervention. The second patient had a minimally displaced coronoid fracture that was also managed conservatively. Therefore, in both cases had the fracture been missed, it would not likely alter their clinical outcome. The other false negative had nondisplaced bilateral angle fractures that were treated with maxillomandibular fixation. This patient presented a week after the injury and it could be that delayed examination confounded the test. We recommend further studies to look into the timing of the TBBT in predicting fractures. Conversely in one patient, the CT scan had not been performed by the ER at the time of ENT evaluation owing to low impact of the trauma and low suspicion of mandible fracture. Positivity of the TBBT was documented to have prompted ordering a CT scan which subsequently revealed bilateral parasymphyseal/angle fractures. The patient then underwent open reduction and fixation of the fractures.

There are several limitations of the study. It is a retrospective review and is not randomized or blinded, and being a retrospective study there is potential for selection bias. Because of the ubiquity of CT scanning in the emergency department, in the large majority of patients, a CT scan had already been performed at the time of initial evaluation by the facial trauma physician and the presence of a mandible fracture may have already been known prior to the exam. There can also be significant interclinician variability of the force of the pull test and it is unknown what effect this would have on the result of the screening test. We suggest a light-to-moderate pull, as instances, where the bite test is positive, are often apparent at the onset of the pull with very little force exerted.

Conclusion

In review of craniomaxillofacial trauma literature, this is the first study analyzing the utility of the TBBT. The test is a quick inexpensive diagnostic tool for the facial trauma physician with high sensitivity and specificity for predicting mandible fractures. When used in addition to a thorough head and neck trauma exam and when taken in context with the history and nature of the trauma, we believe that this test can provide additional indications for avoiding or pursuing further workup such as a CT scan. In the pediatric population, where avoidance of unnecessary CT scans is of highest priority, a wider range of data collection should be undertaken to better assess the utility.

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